

A preliminary study on the relationship between nasal cavity and maxillary sinus volumes.

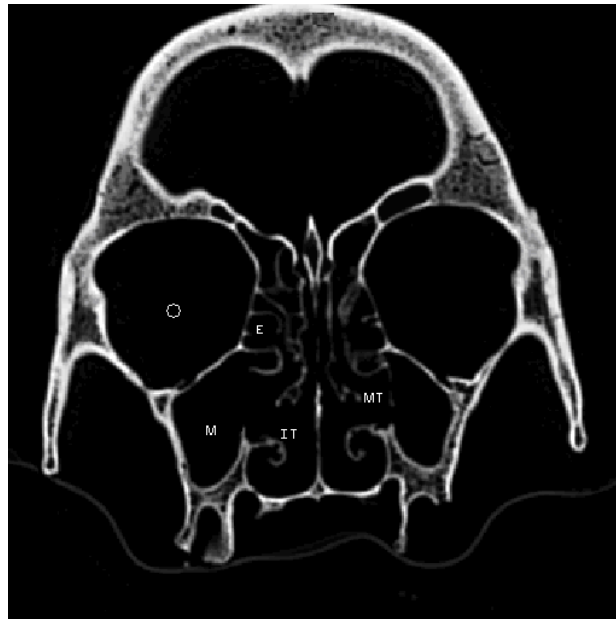
L.N. Butaric¹, D.C. Broadfield², R.C. McCarthy³.

¹Department of Anthropology, Texas A&M University, ²Departments of Anthropology and Biomedical Science, Florida Atlantic University, ³Department of Anthropology, Florida Atlantic University.

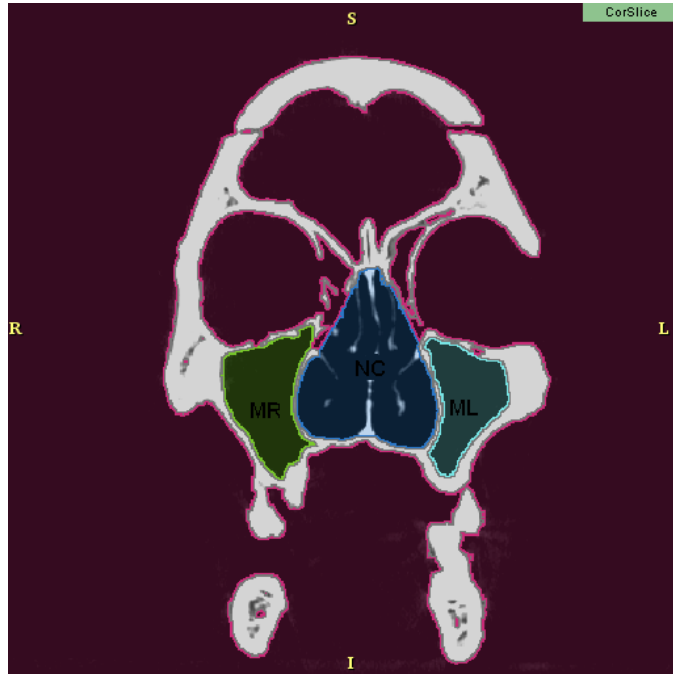
Previous research suggests that nasal cavity volume (NCV), thought to be related to climate, is inversely correlated with maxillary sinus volume (MSV). According to this hypothesis, changes in nasal cavity size and shape reflect physiological needs, such as warming and humidifying inspired air. Owing to volumetric constraints in the mid-face, relative increases in NCV are hypothesized to result in concomitant decreases in MSV, respectively.

To test this hypothesis thirty-nine dried adult human crania from seven different climatic regions were examined using computerized tomography (CT) scans. Significant differences in MSV and NCV between populations were identified using Analysis of Variance (ANOVA). In addition, least-squares and reduced major axis (RMA) regression analyses were performed to test the scaling relationships between MSV, NCV and several cranial size variables.

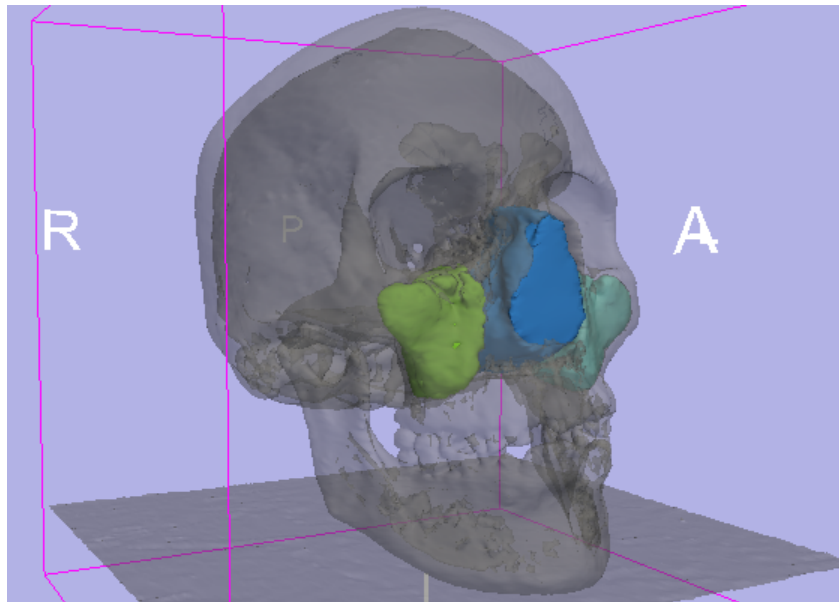
Contrary to previous studies, results indicate that MSV and NCV are not significantly correlated. RMA analyses indicate that NCV, but not MSV, scales isometrically with skull size. Finally, *post hoc* ANOVA results identify significant differences between human populations for MSV that do not follow climatic or environmental trends. These results suggest that (1) it is unlikely that NCV and MSV compete for space in the mid-face, (2) NCV is largely a byproduct of skull size, and (3) NCV and MSV may not be as closely tied to climate as previously thought. Additional genetic and epigenetic factors need to be considered regarding the structure and function of the human maxillary sinus.



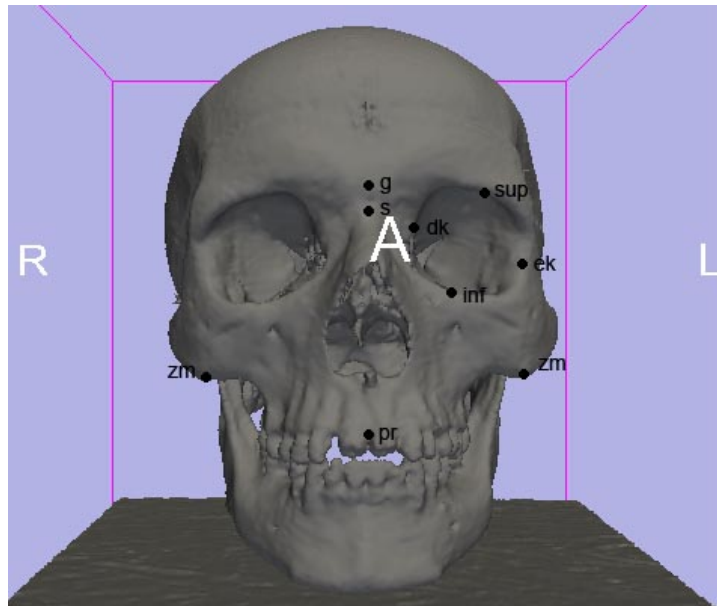
Coronal view of a pre-segmented CT scan. M, maxillary sinus; E, ethmoid air cell; IT, inferior turbinate; MT, middle turbinate; and O, Orbit.



Coronal view of segmented CT scan. NC, nasal cavity; MR, right maxillary sinus; and ML, left maxillary sinus.



Color labels of segmented areas were then rendered using the “Model Module” in Slicer to create 3-D models. Using the “MeasVol Module,” absolute volumes of the nasal cavity and each maxillary sinus were quantified.



Cranial landmarks were taken from the skull models using the “Fiducial Module” within the Slicer program. After each landmark’s 3-D position was recorded, the “Measure Module” was used to calculate the linear distance between particular points to obtain typical cranial measurements (e.g. facial height and cranial breadth).